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## WATER--THE LIFEBLOOD OF CIVILIZATION

Water is the priceless resource on which all growing things depend. It is the lifeblood of civilization.

Where there are ample supplies of good water, vigorous nations can flourish. Farms thrive; cities prosper. When the supply of water fails, farms are abandoned, communities are imperiled, and cities and cultures die, leaving crumbling ruins as their tombstones. This was the fate of ancient Babylon and Nineveh.

In the United States most of the people, and most of the forested areas and croplands, are located in regions of over 20 inches of annual rainfall. In the drier parts of the Western States there are relatively few large towns and cities; usually they cluster around the water supplies derived from high mountain forests. Farther west along the Pacific coast, with its greater rainfall and towering forests, we again find enough water to supply large cities and industries.

The city dweller of the humid East, accustomed to unstinted quantities of water for drinking and cooking, bathing and washing, and sprinkling lawns and gardens, encounters few of the difficulties that beset the inhabitants of semiarid western lands. Yet even he is sometimes brought face to face with local water shortages, resulting from low supplies in reservoirs or in streams that feed his water mains. The eastern farmer confidently expects enough rain to bring his crops through, but sometimes the rains don't come or are poorly distributed. So more and more farmers in the East are installing sprinkler irrigation for emergencies.

But how different it is in the arid parts of the West! Here, where nature is lavish with sunshine but niggardly with moisture, the struggle for existence is largely a struggle for water. Here men once were killed in disputes over water rights, and quarrels about water are still going on. Throughout the Southwest, the farmer or rancher knows that until water can be brought to his land it is worthless for cultivated crops. Also, urban communities in the West have grown tremendously in recent years. More people need water, so they are drilling wells deeper, demanding more water from the mountain watersheds, and transporting it over long distances.

## SOMETIMES WE HAVE TOO MUCH WATER

Newspapers often tell us of floods somewhere in the United States. About every other year in the broad midcontinental valleys, heavy rains and melting snow cause the waters to pour out of mountains and plains, turn brooks into tor-



rents, and swell quiet streams into wild, turbulent rivers. When the rivers become too high or too swift to be restrained, communities are flooded, families flee from their homes, croplands are washed out, and transportation comes to a halt. Hunger, disease, and death stalk the raging waters.

Much more often a torrential storm over a small drainage area causes a little flood which destroys the crops or fences on only a few farms, or floods the streets and buildings of some small town. Although these floods from little streams seldom make city newspaper headlines, in total they cause more damage than the spectacular ones because they are so numerous.

In most of the hilly or rolling sections of the East, before white men settled on the land, spring runoff water was usually absorbed and held temporarily in the porous soils beneath the unbroken expanses of forest. When large areas were converted to farm use, removal of the forest and up-and-down-hill plowing deprived the soils of much of their ability to absorb--and store--water. More of the rain-water ran quickly off the surface and into streams instead of sinking into the soil. The more steeply the land slopes, the more serious this is.

The effects of eliminating or seriously disturbing the natural forest cover are shown in the gullied farmlands and widened stream channels found in some places. Partly because the stream channels are somewhat obstructed by soil, rock, and debris washed down from the uplands, and partly because storm runoff has increased, the channels are no longer able to carry all the flow from heavy precipitation. This is one reason why the streams overtop their banks more often than in the days before settlement.

#### SOMETIMES WE HAVE TOO LITTLE WATER

The same misuse of our land that helps to induce floods is also partly responsible for severe and costly water shortages. When water from rain and snow is not stored in the soil but runs off quickly, there is no reserve to keep streams, lakes, and natural underground reservoirs supplied during the drier months of the year. Periodic decreases or failures of the water supply result in heavy expenditures by large and small communities for the tapping of new sources.

Lack of water sometimes causes serious crop failures. It has actually forced an exodus of people from some regions--for example, parts of the Great Plains where recurrent duststorms and depleted soils have made farming difficult. It has imperiled California's Central Valley, one of our great farming regions. Underground supplies in Arizona are being pumped out for use faster than they are replenished.

Lack of a dependable year-round water supply prevents the establishment of new industries in a community. Many kinds of industries require great quantities of water. One of the first questions in deciding where to locate an industrial plant is, "Can we obtain a continuous and adequate supply of pure water here at reasonable cost?"

All Americans have a vital interest in preventing water shortages.

#### SOMETIMES WE HAVE POLLUTED WATER

The purity of water is just as important as its quantity. The water in many of our rivers is so polluted that it is unfit for human use without expensive purification treatment. Often it is unfit for fish. There are many sources of pollution--

sewage, industrial wastes, drainage from mines and oil wells, and so on. But the biggest pollutant of water is silt.

The silt in our streams comes from erosion of soil from croplands and grazing lands, from construction projects in cities, and even within forests where vegetation cover is lacking and flow of water is concentrated. Improper road-building, logging, surface mining, grazing, and fires in forests all can cause serious erosion. Too concentrated recreation use in forests can also result in soil erosion and water pollution.

Forest lands are the source of over half of the waterflow in streams of the United States. They are the best potential source of pure, fresh surface water at low cost. Thus it is especially important that any causes of water pollution in forests be reduced to a minimum or eliminated.

## HOW SOIL, FORESTS, AND WATER ARE RELATED

Forest land, in addition to providing timber, forage, wildlife habitat, and recreational opportunities, has immense value as a regulator of waterflow. Forest soils retain moisture and store water; their physical condition has much to do with controlling water movement both on and beneath the surface.

The forest floor is protected by the tree crowns of different heights and often a mass of shrubs and herbaceous plants below. The surface itself is a mat of leaves, twigs, and other plant remains. Beneath this loose dead plant material is a layer of partly decomposed vegetation, and below that, a layer of more or less disintegrated organic matter.

Underneath these organic layers is mineral soil, also occurring in layers. The upper layer or topsoil is considerably enriched with organic material and permeated with growing and decomposed plant roots and the minute channels of innumerable earthworms, mites, insect larvae, bacteria, and fungi. All this biologic activity keeps the soil porous and gives it a crumblike structure, ideal for holding, storing, and percolating large quantities of water.

Below these layers is the subsoil. Except for the penetration of deep roots and the burrowing of insects and rodents, it contains few large, connected openings and has a much tighter structure. Therefore, the subsoil often absorbs water more slowly and may inhibit percolation to ground water reservoirs.

Thus the speed and volume of water movement through the soil depend on its structure and the shape and continuity of the large pore spaces formed by plant roots and by animal and insect activity. Any soil can store only a certain amount of rainfall. Hence the amount of water already in the soil determines how much more will be stored during a storm. The upper layers of forest soils when in good condition will generally take in water quickly and can hold as much as 35 percent of their total volume.

Snow accumulation and melting are also influenced by forest cover. Although the total snow accumulation will be less in a dense coniferous forest than in treeless openings, the snow on the forest floor, when protected from sun and wind, will remain from 1 to 5 weeks longer than on exposed sites. Delay of snowmelt usually reduces high streamflow in the early spring and releases water later, when it is most needed. Also, more of the melting snow is absorbed by the loose, porous, and frequently unfrozen forest soil than by the soil of open fields, which is commonly frozen.



When rain falls in the forest, part of it clings to the leaves or needles of trees and other plants, some evaporates, and some trickles down the plant stems. In a hard or long rain, much water falls directly on the forest floor, infiltrating into the soil and gradually filling its pores. For use in the life processes of plants, some of this water is pulled up into the stems and leaves and then is transpired into the air. When the surface soil cannot absorb all of the water that reaches it, some runs off over the ground.

Another part of the rain moves downward to become a part of the ground water table that supplies our springs and streams. After the rain stops, slow drainage through the soil may continue on steep slopes for many days, and this water helps provide the base flow that sustains many of our mountain streams.

## MANAGEMENT OF FORESTED WATERSHEDS

An area of land that drains into a stream is called a watershed. The watershed land receives water from rain and snow, stores some of it, and releases the rest into a stream. The purity of water reaching a stream, its total amount, and the regularity of flow are all affected by the conditions of the soil and its forest and other plant cover.

Good watershed management strives to insure that soils stay in place and are not eroded away into stream channels. It avoids the destruction of forest or grass cover on large areas by fires or unwise logging or grazing. It attempts to restore plant cover promptly on areas already denuded, and heal or stabilize eroding gullies and streambanks. It sees that roads and logging skid trails are located so that they do not start big gullies or release masses of debris into streams. It regulates uses for recreation so as to avoid destruction of the plant cover and pollution of water supplies. In some circumstances it may include replacement of deep-rooted trees, which consume great amounts of water, with shallow-rooted plants such as grass to increase the outflow to a stream supplying a community.

Good watershed management seeks to adjust the various uses of natural resources so as to conserve them, to keep the soil in place, and make water available in a manner that best suits human requirements.

## HOW WE CAN HELP SAFEGUARD THE NATION'S WATERSHEDS

In a broad sense, all of us are responsible for maintaining our watersheds in good condition--timberland owners, loggers, farmers, ranchers; hunters and fishermen, berry pickers, tourists, hikers, campers; and even stay-at-home city folk.

Just as costly illness or a surgical operation may follow persistent neglect of personal hygiene, the abuse of watershed lands and forests may require expensive measures and perhaps decades of time to restore their health which is so essential to the Nation. All landowners and users must work together to enforce the simple rules of forest "hygiene." For example, we must be extremely careful not to throw away burning material or allow camp or picnic fires to burn unattended. Forest owners must employ every means to prevent wildfire, eliminate improper cutting and log-skidding practices, and minimize grazing damage.

Urban water users and valley dwellers, though remote from the watershed forests, usually suffer the consequences of damaged uplands. These groups should demand, in particular, that landowners and users take the needful steps to prevent erosion and rapid runoff. They also have responsibility for not wasting water, or using it without considering others' needs.

Each of us must share responsibility for safeguarding our forested watersheds.

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